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FACTS ABOUT

BHP CONSTRUCTION

A MASSACHUSETTS WATER RESOURCES AUTHORITY PUBLICATION – FALL 1996

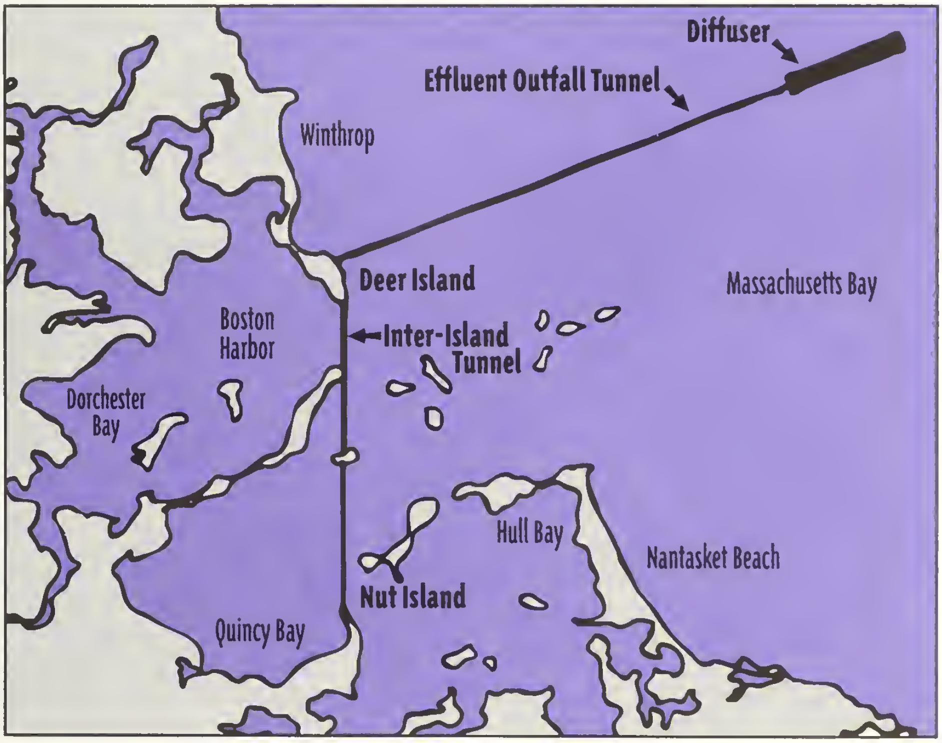
The Massachusetts Water Resources Authority is building new wastewater treatment facilities to control the pollution of Boston Harbor. The project is part of MWRA's effort to upgrade and manage wholesale water and sewer systems for eastern Massachusetts. The Boston Harbor Project (BHP) is one of the biggest public works projects ever undertaken in New England. The project consists of the nation's second largest wastewater treatment plant, a sludge-to-fertilizer facility, 15 miles of undersea tunnels, two new headworks and dozens of supporting facilities.

THE COURT ORDER

The harbor project is being carried out under a 1986 federal court order issued by U.S. District Court Judge A. David Mazzone, who determined that wastewater discharges into Boston Harbor violated the Federal Clean Water Act of 1972. The judge directed the construction of new treatment facilities and issued a long-term timetable for project completion. The order was the culmination of a series of legal actions that began in December 1982, when the City of Quincy filed suit in Massachusetts Superior Court charging that wastewater discharges to the harbor violated state law.

PREPARING FOR CONSTRUCTION

The Boston Harbor Project's construction sites, Deer Island and Nut Island, demanded innovative techniques to accommodate a multibillion dollar, decade-long construction project. Although Deer "Island," the main site, is actually a 210-acre peninsula connected to the town of Winthrop by a thin strip of land, MWRA treated it largely as an island. Project designers devised a water transportation system to move people and materials to and from construction sites, centralized services to save vehicle trips and space, and planned a system to sequence contracts so that all project components would not be under construction at the same time.



PROJECT LABOR AGREEMENT

At the start of the project, MWRA planners estimated that work stoppages during construction could cost ratepayers as much as $2 million per day and could endanger progress on the court-ordered schedule. One of the first tasks for ICF Kaiser Engineers, MWRA's Construction Manager, was to negotiate a labor harmony agreement with unions involved in project construction.

The result, known as a Project Labor Agreement, is an accord under which unions promised not to strike or otherwise interrupt work, and contractors agreed to hire trade workers through union hiring halls. All disputes were to be resolved through binding arbitration.

As of late 1996, workers had logged more than 20 million hours without any time lost because of labor strife.

Having withstood a challenge in the Supreme Court, the labor agreement's success has prompted project owners nationwide to negotiate similar agreements. These include the Central Artery/Third Harbor Tunnel project in Boston and Denver Airport.

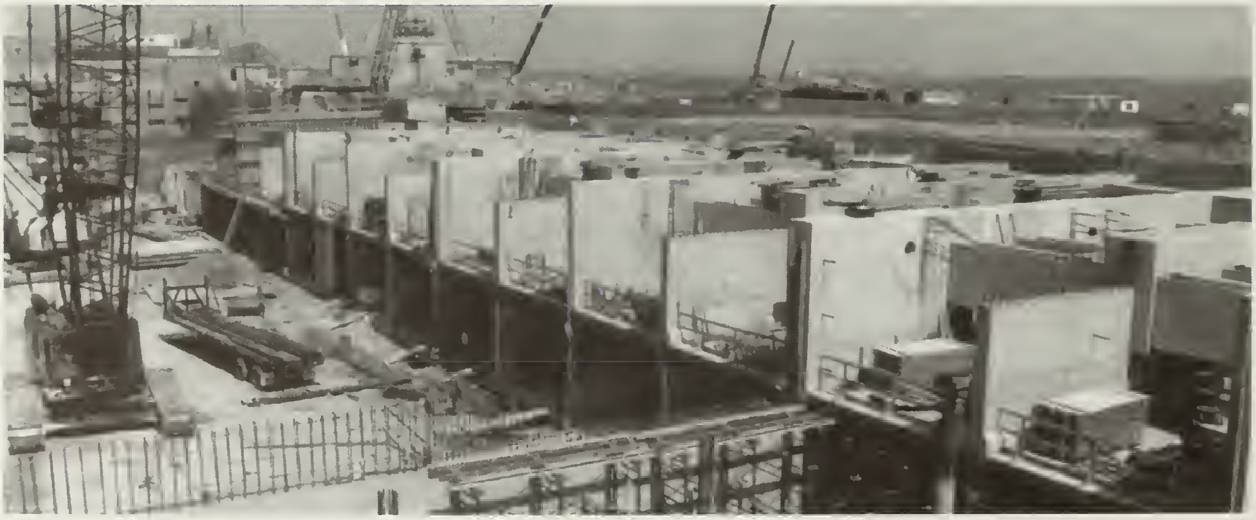
MOVING A MOUNTAIN

Before construction could begin, a glacial drumlin (large hill) in the center of Deer Island was relocated to form a barrier between the adjacent community of Winthrop and the construction and operation of the new treatment plant. The island's history as a military installation and site of a prison meant that concrete bunkers and existing structures had to be removed to make way for the new plant. To further complicate construction, the work had to be performed around the existing primary plant, which remained operational until new primary treatment facilities were completed in 1995.

WATER TRANSPORTATION SYSTEM

The provision of water transportation was a condition of the federal court order that guides the Boston Harbor Project, a mandatory mitigation measure of the U.S. Environmental Protection Agency and a demonstration of the Authority's commitment to control the project's impact on neighboring communities such as Winthrop.

MWRA built new piers at Deer and Nut Islands, Squantum Point and the Fore River Staging Area (FRSA) in Quincy and began ferrying workers in 1990. Other project personnel travel by bus from the Suffolk Downs race track. Roll-on/roll-off piers at Deer Island and FRSA allow project vehicles, bulk materials and supplies to be stored at the former shipyard and transported to Deer and Nut Islands by barge. At peak construction, approximately 3,000 workers commuted to Deer Island daily by bus and ferry. By fall 1996, more than 181,000 vehicles had traveled across the harbor on barges.



STACKING THE NEW PLANT'S TREATMENT TANKS IN ROWS OF 12, TWO STORIES HIGH, HELPS CONSERVE SPACE ON DEER ISLAND.

CONGESTION ON THE BOSTON HARBOR PROJECT'S ISLAND SITE CHALLENGED PROJECT DESIGNERS TO COME UP WITH ALTERNATIVES TO CONVENTIONAL CONSTRUCTION METHODS.

Centralized services

To save space and reduce the number of vehicles on the construction site, MWRA established centralized services such as fuel supply, road maintenance and trash removal. A batch plant that will ultimately produce one million cubic yards of concrete was constructed to provide the critical building material for all project contractors.

New technologies

MWRA's desire to conserve space and keep costs as low as possible prompted project engineers to seek new technologies for the plant from around the world, especially from countries where limited space is an issue. The project took advantage of several designs developed in Japan and Germany, including stacked clarifiers and egg-shaped sludge digesters.

A system for stacking clarifiers (large concrete settling tanks) on two levels replaced the conventional side-by-side design of the old Deer Island plant. A stacked configuration uses 30 acres as opposed to 70 acres for a conventional layout. It was a key piece in fitting the plant into Deer Island's limited space.

The twelve 15-story sludge digesters are the project's most visible element. MWRA selected the egg shape for its digesters because they require a fraction of the space needed for conventional "pancake" tanks and because they are essentially self-cleaning. Eight of the digesters were fabricated in South Carolina and the remaining four in Quincy. They were barged to the island and placed into ring foundations. Each digester has a three-million-gallon capacity.

Elbow room for contractors

Years before the first bulldozers rolled onto Deer Island, Boston Harbor Project designers had a plan. They knew how hundreds of contracts, miles of utility cables, dozens of companies and over 3,000 people would work together to build one of the country's largest public works projects on a relatively small piece of land.

A site utilization plan defined every phase of construction, utility locations and access roads, and formed the basis for day-to-day construction planning. Each contract's specifications set out precise dates for starting and completing work, assigned laydown and storage areas and described how one construction contract fit with dozens of others. The planning process stayed several years ahead of construction to make sure that construction vehicles had roads to drive on and to avoid moving permanent utility installations.

Project safety

During peak construction, as many as 30 contractors, 3,000 workers and hundreds of pieces of equipment worked side by side on a congested construction site. By establishing construction safety as its highest priority, MWRA developed and implemented an innovative and highly successful safety program.

The program unites construction managers, contractors and workers in a common cause. Drug and alcohol testing were made part of the program, as well as regular practice emergency drills, weekly "tool box" meetings between supervisors and workers and a variety of safety-incentive programs. The project provided special training in high-risk occupations, such as tunneling. The construction manager brought in four safety specialists and worked with the U.S. Occupational Safety and Health Administration to resolve any safety violations.

According to recent statistics, the project has a lost-time incident rate that is the lowest in the nation for public works projects of its size and 59 percent lower than the lost-time rate for heavy construction issued by the Massachusetts Department of Labor and Industries. The project has received several awards for its safety program, including the New England Construction Users Council's *Excellence in Construction Safety* award in April 1996.

Effluent outfall tunnel

MWRA currently discharges effluent (treated wastewater) into shallow harbor waters off Deer Island. A new outfall now under construction will release these discharges in deep Massachusetts Bay waters, 9.5 miles from Deer Island. Construction got underway in 1990 when a 27-foot-diameter, 720-ton tunnel boring machine arrived on Deer Island in pieces. The components were lowered into the 420-foot shaft and assembled before the TBM began its drive beneath the harbor floor.

As the tunnel bore began, another contractor was installing a 55-riser-pipe diffuser system in Massachusetts Bay. The system's connection to the last 1.25 miles of the tunnel began in early 1996 (see box next page).

A 27-foot diameter tunnel boring machine drilled round-the-clock, guided by a laser beam, to excavate the harbor project's effluent outfall tunnel.

A steel digester section weighing several hundred tons is lifted into place on Deer Island.

Inter-island tunnel

On the other side of Deer Island, a smaller TBM was drilling southward, excavating a five-mile tunnel that will carry screened wastewater from the new Nut Island headworks to Deer Island for treatment. The tunnel also contains two parallel pipelines, the first leg of a system that will convey sludge from Deer Island to the FRSA processing plant, where the wastewater treatment residue is already being converted into fertilizer pellets.

Schedule and budget

Although MWRA has encountered some delays in excavating project tunnels, the overall project is still scheduled for completion in 1999. Because flows to the new plant are much lower than expected, MWRA has reduced the size of the secondary treatment plant while still maintaining treatment standards. Competition for the work has resulted in lower-than-expected construction bids. These factors – and tight management – have contributed to the project's being approximately $700 million under budget.

INSTALLING THE DIFFUSER SYSTEM

For 10 months in 1991-1992, a barge that resembled an oil-drilling platform moved along the last 1.25 miles of the new effluent outfall tunnel's path. The elevated barge served as a construction deck for crews installing 55 riser pipes and caps that are being connected to the tunnel to ensure the thorough dilution of effluent with seawater.

Each riser consists of a 30-inch-diameter pipe that rises 250 feet from the tunnel to the seafloor. The pipes were inserted into predrilled holes, then topped with diffuser cap assemblies with mushroom-shaped, protective polyethylene domes.

Project engineers credited both the contractor and cooperative weather for the fact that installation was completed one year ahead of schedule.

A crew following the tunnel boring machine began to connect the tunnel to its riser pipes in spring 1996. All 55 connections are expected to be completed in 1998. The Massachusetts Water Resources Authority expects to begin discharging wastewater through the diffusers in 1998.

A CONSTRUCTION MODEL

Visitors from dozens of countries have toured harbor project construction sites. Drawn to the project's scope and management structure, engineers, elected officials and project managers are looking to MWRA as they plan large-scale responses to pollution problems around the world. Interest in the project proves that protecting the earth is a challenge without borders.

ENVIRONMENTAL IMPACTS

Although the project is still several years away from completion, water quality improvements in Boston Harbor can be attributed to the Boston Harbor Project.

Beach closings decreased when MWRA removed sludge and floating debris from wastewater and improved the Deer Island treatment plant's pumping capacity, which has reduced wet weather sewage overflows. Ending sludge discharges greatly improved the clarity and quality of Boston Harbor

MANAGING PROJECT CONSTRUCTION

MWRA established an in-house Program Management Division (PMD) to direct Boston Harbor Project design and construction. To avoid creating a large in-house staff, MWRA opted to use a private-sector Lead Design Engineer and Construction Manager, guided by PMD to oversee project design and construction. This structure: (1) allowed the newly created MWRA to recruit dedicated staff with relevant skills for the life of the project, (2) permitted work to start as soon as consultants were hired, (3) gave MWRA access to experts from around the world, (4) avoided periodic staff increases and decreases, (5) brought credibility to the project at a time of low respect for public agencies, and (6) transferred professional liability risks to private-sector firms contracted for the project.

waters. An aggressive toxic reduction and control program has reduced levels of hazardous waste in flows to the treatment plant by working with industries and homeowners to alert them to alternative disposal methods or safer chemicals.

ECONOMIC IMPACTS

Economic benefits are also part of the picture. Investments in Massachusetts water and sewer systems are creating jobs and ensuring economic stability and competitiveness.

A report on the Boston Harbor Project's economic impact predicts that the project will generate the equivalent of over 23,000 full- and part-time jobs. Those jobs include approximately 900 construction jobs in the average year.

The study estimates that by the time construction is completed at the end of the century, over $1.6 billion will be spent within the local economy, generating an additional $1.4 billion in spin-off activity.

In addition, the study estimates that new tax revenues from the project will average $8.6 million annually over the construction period and total $129 million over the life of the project.

MASSACHUSETTS WATER RESOURCES AUTHORITY

The Massachusetts Legislature created MWRA in 1985 to manage water and sewer services for 2.5 million people and 5,500 businesses in 61 communities. While the Boston Harbor Project is the best known of MWRA's projects, the Authority also maintains 400 miles of water pipes, aqueducts and tunnels, and 228 miles of sewers. Also underway are projects to control combined sewer outflows, provide adequate water delivery and meet all federal, state and local water and sewer standards.

THE BOSTON HARBOR PROJECT

MWRA's effort to control the pollution of Boston Harbor is centered around two programs: the Boston Harbor Project and the Combined Sewer Overflow Control Plan.

The Boston Harbor Project is a $3.4 billion, 11-year program to construct new wastewater treatment facilities at Deer Island. When completed at the end of the century, the project will ensure that wastewater discharges from 43 sewer-service communities meet all state and federal standards for protecting public health and the marine environment.

The project includes a new primary and secondary treatment plant on Deer Island; a headworks on Nut Island; a five-mile long tunnel connecting the headworks with the treatment plant and related facilities. A new 27-foot-diameter, 9.5-mile-long tunnel will discharge treated wastewater through 55 diffusers into Massachusetts Bay, ensuring that the effluent is well mixed with sea water.

The CSO Control Plan will reduce pollution from 81 CSOs in the region that can carry a combination of stormwater and sanitary sewage into the harbor and its tributaries during rainstorms. The completed project will reduce the volume of CSO flows by 84 percent over 1988 conditions and provide screening and disinfection to 96 percent of the remaining flow. Many outfalls will be closed or diverted. The plan will result in significant water quality improvements.

MWRA offers a wide variety of informational materials on the region's water and sewer systems and the natural environment. To find out what's available, contact MWRA's Public Affairs Department at:

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